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Review on Retention of Placenta in Dairy Cows and it is Economic and Reproductive Impacts

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Abstract
Fetal membranes or what is known as "placenta" is an essential organ for prenatal transfer of nutrients and oxygen from the dam to the fetus. The normal separation of fetal membranes consists of complex hormonal process that starts before parturition in cows, which drops within short time after birth. It normally drops within short time post partum. If the placenta is not expelled within certain time (12 h post calving and 3 h post foaling), it is defined as being retained placenta (RP). Its a condition where all or part of the placenta or membranes are left behind in the uterus during the third stage of labour. Retained placenta creates a number of problems following pulling of microorganisms into the uterus causing its inflammation, decreased milk yield, longer calving intervals, reduction of fertility, longer calving interval, and reduce conception rate**.** RP causes great economic losses, mainly due to decreased milk yield and loss due to infertility. The number of risk factors of retained placenta includes stillbirth, dystocia, abortion, twin, fetotomy, induction of parturition, cesarean section, shortened gestation, managemental system, heridetary, hormonal, infectious disease and maternal immune system. Since there are many causative agents of retained placenta, the treatments which are commonly used for the retention of fetal membranes do not show the significant effects. Therefore, Basically, we have to avoid the occurrence of dystocia through genetic selection of dam and sire having minimal probability for RP, proper prepartum nutritional status and exercise. Special care should be paid for nutrition and vitamin supplementation, especially during the dry period.
It could be concluded that RP is an important problem which causes great economic losses and leave the animal subfertile even after treatment and recovery. So, it is recommended to control the condition rather than to treat it.
Keywords: Cows, Retention of placenta, Risk factors, Placental detachment, Dystocia.

INTRODUCTION

A fetal membrane is an essential organ for prenatal transfer of nutrients and oxygen from the dam to the fetus [1]. The other functions of placenta is it provides a reservoir of blood for the fetus, delivering blood to it in case of hypotension and vice versa, comparable to a capacitor [2]. When the fetus is born the placenta normally detaches within short time and is expelled. That is why it is referred to as the "afterbirth"[3]. The release of fetal membranes postpartum is a physiological process and involves loss of fetomaternal adherence, combined with contraction of uterine musculature and is usually accomplished within 6 hours of calving [4]. Normally fetal membranes drops within short time post partum (within 8 hrs of parturition), if it is retained up to 12 hrs then it is called as delayed removal and if retained for more than 24 hrs of parturition then it is called as 'Retention of placenta' (ROP). The key element in the pathogenesis of retained placenta in cattle is a failure of timely breakdown of the cotyledon-caruncle attachment after delivering the calf [5].

Retention of fetal membranes is the most common condition occurring in domestic animals following parturition [6]. Its incidence varies from 4.0-16.1%, but can be much higher in problem herds. However, it can be much higher in problem herds and also increases during summer with increased parity, milk yield in the previous seasons and following birth of male fetus [7,4] Abortions, stillbirths and twin calvings resulted in increased incidence rates of 25.9, 16.4 and 43.8%, respectively. There are number of common causes that predispose for retention of fetal membranes, including mechanical, nutritional; managemental and infectious factors. Dystocia, caesarean section, uterine torsion, abortion, stillbirth, and twin birth are mechanical causes of RFM. While nutritional causes may be due to deficiency of protein, selenium, iodine, vitamin A and E and calcium deficiency during pregnancy. Managemental causes of retained placenta include stress hereditary, inbreeding and obesity [8]. Infectious causes is associated with brucellosis, salmonellosis, leptospirosis, and listeriosis [9, 10, 11]. Such retention creates a number of problems by allowing microorganisms to grow inside the uterus causing inflammation, fever, weight loss, decreased milk yield, longer calving intervals and may result in an open cow during the next year and if the infection is so bad the animal may actually die. Retained placenta is among the main reproductive disorders in farm animals especially, dairy cattle. It causes considerable economic losses in the herd due to decreased milk production, illness and treatment cost, beside a decreased market value of the animal [12, 13].

Diverse therapeutics has been employed for treatment of RFM. Manual removal, administration of intra-uterine and/or systemic antibiotics, injection of oxytocin, PGF2α and β2-receptor blockers; all assisted in prevention/treatment of RFM [14, 15, 16, 17]. Because RFM negatively affect milk production and cow's

fertility, effective treatment is crucial for improving puerperal performance of cows in order to raise their productiveness. Therefore, the aim of this paper is to review literatures on retention of fetal membranes in dairy cattle and to disseminate relevant information.

Literature review

Placenta

The placenta (Fetal membrane) is an organ that connects the developing fetus to the uterine wall to allow nutrient uptake, provide thermo-regulation to the fetus, waste elimination, and gas exchange via the mother's blood supply, fight against internal infection and produce hormones to support pregnancy. Placentas are a defining characteristic of placental mammals, but are also found in some non-mammals with varying levels of development [18]. It provides oxygen and nutrients to growing babies and removes waste products from the baby's blood. The placenta attaches to the wall of the uterus, and the baby's umbilical cord develops from the placenta. Other functions of placenta is it provides a reservoir of blood for the fetus, delivering blood to it in case of hypotension and vice versa, comparable to a capacitor [2]. The umbilical cord is what connects the mother and the baby. The essential materials pass to the developing fetus. When the fetus is born the placenta normally detaches within short time and is expelled. That is why it is referred to as the "afterbirth" [3]. The release of fetal membranes postpartum is a physiological process and involves loss of fetomaternal adherence, combined with contraction of uterine musculature and is usually accomplished within 6 hours of calving [4].

Retained placenta

Retention of placenta is the inability of fetal membrane to be expelled within 8 hrs after parturition and ranging of the retention from 8 to 48 hours post partum [19]

The normal physiological stages of birth during parturition include dilatation of parturient canal, delivery of the fetus and expulsion of the fetal membranes. In normal condition, fetal membranes are usually expelled within two to eight hours of parturition. Any retention of fetal membranes beyond 12 hours could be considered as pathological [20]. The incidence of retained placenta varies from 4-18% of calving [21, 22, 23]. The uterus normally contracts approximately fourteen times an hour immediately following parturition but the frequency gradually diminishes to once every hour at 42 hours. Delayed involution of the uterus is usually associated with retention of membranes. Retained placenta had a significant negative effect on milk yield for several weeks after calving [24, 25]. The interval from calving to first service and conception were higher in the retained placenta and increases the risk of fatty liver syndrome and ketosis [10]. Retained placenta delays the postpartum resumption of cyclic ovarian function and prolongs the interval from calving to first ovulation [26]. Early or induced parturition, dystocia, hormonal imbalances, and immune-suppression are risk factors in interrupting the normal process resulting in retention of the placenta. Systemic administration of antibiotics can be beneficial in treating metritis and collagenase injection enhances placenta release during fetal retention [19].

Mechanism or pathogenesis of placental retention(Recent knowledge on pathogenesis of placental retention in cattle [27]

The key element in the mechanisms of retained placenta in cattle is a failure of timely breakdown of the cotyledon-caruncle attachment after delivering the calf.

Mechanism of normal placental separation

Maternal immunological recognition of foetal MHC class I proteins expressed by trophoblast cells triggers an immune/inflammatory response that contributes to placental separation at parturition. The processes leading to normal separation and delivery of the placenta are multifactorial and begin before parturition (Fig 1). For example, it has been suggested that serotonin might also play a role in regulating bovine placental attachment [28]. High fetal and placental serotonin during pregnancy could help to maintain placental attachment by promoting placental cell proliferation [28] and inhibiting matrix metalloproteinase (MMP) activity [29]. Maturation of the fetal monamine oxidase enzyme system close to parturition results in the metabolization and subsequent decrease in serotonin, which in turn could promote placental separation and parturition [28].

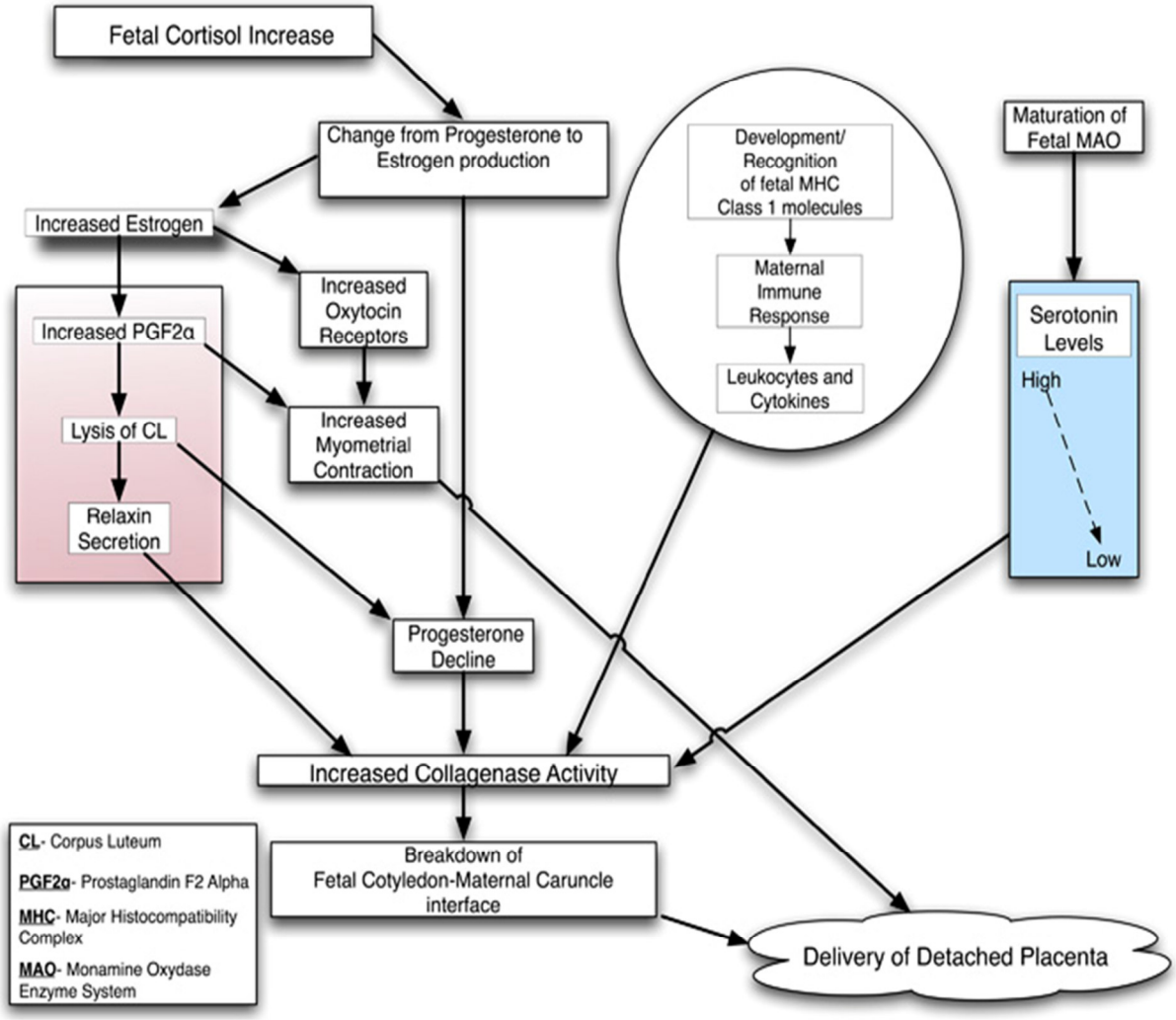

FIGURE- 1: Physiologic processes leading to the detachment of the placenta in dairy cows**.**

Mechanism of placental retention

Chemotactic factor for leukocytes is found in placentomes of cows with normal placental separation. It is absent in placentomes from cows with retained placentas. Blood leukocytes and neutrophils of cows with retained placenta are less reactive to chemotactic stimuli than in cows with normal placental separation. The cows with a greater degree of negative energy balance prepartum and higher non-esterified fatty acid (NEFA) concentrations were 80% more likely to suffer from retained placenta. Similarly these authors found higher risk for retained foetal membranes in cows with lower circulating vitamin E concentration.The recent data indicate that lack of uterine motility plays little or no role in the occurrence of retained placenta. Moreover cows with retained placenta have normal or increased uterine activity in the days after calving [15].

Etiology

ROP denotes the failure of the fetal villi to separate from the maternal crypts i.e. the lack of placental dehiscence. The causative factors are:

Infectious disease

Infectious disease causes of placental retention are behind the scope. Infectious diseases like Bovine Viral Diarrhea may cause RFM in cattle [30]. Brucellosis is a contagious bacterial disease of sexually mature animals and causing abortion and retained placenta [31, 32]. The disease is clinically characterized by abortion in the last trimester and retained placenta in the female whereas orchitis and epididymitis in male [33].

Managemental

Managemental causes of retained placenta include stress hereditary, inbreeding and obesity [8].

Lack of exercise and hypocalcemia are the most frequent causes of decreased myometrium contractility. Stress (Transportation, rough handling, poor feed conditions, Isolation from group, Lameness,) results in elevated corticosteroids and increased risk of placental retention.. Dairy producers have suggested that Poor health

management in herds can predispose animal to retention of placenta [34]. In addition to this deficiency of antioxidant, vitamin E and selenium may decrease chemo taxis and leukocyte numbers at the fetomaternal junction, thus contributing to the retention of fetal membranes [35]. Over-condition and under condition as well as managemental defects and environmental factors can result in retention of placenta [36].

Nutritional

Nutritional causes of RP are primarily due to the deficiency of feed during the last 6 to 8 weeks before calving specially when there is deficiency of content of minerals and vitamins in diet [37]. Heavy grain feeding may be associated with both higher milk production and increased risk of reproductive disorders such as dystocia, retained placenta, cystic ovaries, metritis other reproductive disorders [38]. Vitamin and mineral deficiency conditions such as selenium, vitamin E and vitamin A, B-carotene and disturbed Ca/P ratio can impair general immunity and may alter the competence of cellular self-defense mechanism and can increase the risk for placental retention and metritis [39]. High milking cows with a greater degree of negative energy balance prepartum and higher NEFA concentrations were more likely to suffer from RP [11]. On the other hand, over-conditioned cows were shown to be more sensitive to retained placenta and subsequent infertility than cows with normal body condition scores [40].

Cow's body weight

The percentage of retained placenta increases significantly with increasing live body weight of cows due to the increment in fat adipose tissues [41], which may result in trapping the steroid sex hormones.

Calves' birth weight

A significant increment of retained placental problem is happening with increasing fetal birth weight [41]. The reason could be due to pressure of the fetus on the placenta and fetal membrane [42], so that the attachment between the cotyledons and the fetal membrane become stronger these consequent in occurrence of placental retention.

Failure of maternal Immune Response

It is occurred due to failure of the maternal immune system to successfully degrade the placentomes at the end of pregnancy [15]. Maternal immunological recognition of fetal MHC class I proteins expressed by trophoblast cells triggers an immune inflammatory response that contributes to placental separation [43]. This lymphocytic activation was suppressed at the foeto maternal interface alongside the pregnancy course to avoid rejection of fetal allograft where the trophoblast secretes interferon-tau (IFN- t) and both trophoblast and endometrium secrete prostaglandin E2 and the endometrial glands secrete serpins (uterine milk proteins), all of which inhibit lymphocyte activation to keep on the embryo not rejected by the dam [44].

Hormonal

Placental separation occurs when fetal cortisol induces the production of the enzymes, 1 7-hydroxylase and aromatase in the placenta which favour oestrogen synthesis at the expense of progesterone synthesis [1]. Maternal plasma levels of oestradiol- 1 increase suddenly, while plasma levels of progesterone decline sharply immediately prior to parturition. It is supposed during the week before parturition, the level of estradiol reaches its maximum level to help the uterus to get rid of any remnant of fetal membranes. Therefore, a decreased level of estrogen may be indicated as a factor enhancing RP [45]. Spontaneous myometrial contractility is augmented by autocrine and paracrine release of PGF and parturition ensues. Disturbed endocrine function high progesterone and cortisol levels and low oestradiol level was traced in the blood cows with RP [46]. Increased progesterone level in RP may be due to failure of the placenta to produce specific steroidal enzymes that help in progesterone aromatization and its conversion to oestrogen [3].

Mechanical Causes of Retained Placenta

Difficult birth(calf too large for cow, backwards calf known as breech birth, one leg or head backwards), twins, late or premature birth, prenatal loss, induction of parturition with PGF2 , cesarean section and fetal monsters or emphysematous fetus (gas-filled fetus) are direct causes of dystocia and consequently to RP.

Failure of cotyledon-caruncle detaching mechanisms

The main cause of retained placenta is due to a lack of breakdown of the caruncle-cotelydon attachments after delivering the fetus [47]. The reasons could be due to infectious and/or noninfectious factors [48]. Primary attention has been often directed to infectious causes, but non infectious factors probably account for 70% or more of the cases [15]. Noninfectious causes are often multifactorial and are difficult to diagnose [49].

Risk factors

There are a number of risk factors associated with RFM, including Age, parity, induction of parturition by with PGF2 alpha [50], Repeatability, stillbirth, shortened gestation [51], abortion of fetus [52], twinning[51], dystocia [24], fetotomy [53], Cesarean section [52], nutritional deficiencies such as vitamin E, selenium, and carotene [54], immunosuppression [55], metabolic disorders, especially milk fever.

Infectious agents such as bovine viral diarrhea virus[30], brucellosis [31,56], leptospirosis, vibriosis, listeriosis, IBR , Trichomoniasis, Listeria monocytogenes, and etc. Whereas the exact mechanism responsible for

these factors is not completely known, the complex process of multiple hormones and biochemical events leads that disturbance in these events causes the RFM. The studies of physiological factors which are responsible for the detachment of fetal membranes help in the diagnosis of etiologies of RFM.

Reproductive Impact of Retained Placenta

The fertility of the dairy cows is affected when most cows in the herd suffer from retained placenta. These causes direct loss to the farmer due to delayed calving leading to a lengthy period between births (calving intervals) and hence low milk production. The adverse effects of RFM on reproductive performance of cattle are: delay in first service [57], reduction of pregnancy rate [58], increase in services per conception [59]. The RFM also leads to endometritis, puperal metritis and mastitis [60] and these diseases ultimately cause the reduction in the fertility and milk production of cattle [55].

Mastitis

Although the main economic impact of ROP seems to be decreased milk production, more days open, decreased milk volume, milk from treated cows withheld), the correlation between ROP and mastitis is controversial. However, the economic losses as a result of mastitis could be due to reduced milk production, discarded milk, reduced cow sale value, drugs and veterinary services. It is unhygienic to milk a cow with decomposing afterbirth hanging on it [11].

Metritis

Retention of placenta and metritis are positively correlated. Cows with ROP had a significantly higher incidence of metritis than cows without ROP and also a significant difference was found between conception rates in cows with ROP and metritis [61]. Retention of placenta results from the presence of decomposing placental tissues, which provide a favorable environment for bacterial colonization. Coliform bacteria and high concentrations of endotoxins present in lochia of cows with ROP are potent inducers of prostaglandins and cytokines, favoring development of uterine infections [62]. Metritis result in decreased dry matter intake, and hence, multiparous cows with metritis in early lactation produce less milk than the healthy cows. This difference is greatest during the first 20 weeks of lactation [63].

Economic consequences of retained placenta

Retained placenta, one of the main causes of endometritis in cattle, causes economic loss [64, 65] Kossaibati and Esslemont [66] calculated the direct cost of a case of retained placenta to be about £ 83, with an over-all cost of £ 298.29 (1995 prices).

Losses due to infertility and low milk production

In dairy cows retained placenta may be the cause of serious economic losses to the farmers as cows with retained placenta may develop bacterial infection and become ill and thus reduce production. Some may even die. Milk from cows with retained placenta is unfit for human consumption and therefore cannot be sold. The fertility of dairy cows is affected when most cows in the herd suffer from retained placenta. This causes a direct loss to the farmer due to delayed calving leading to a lengthy period between births (calving intervals) and hence low milk production. The retained fatal membrane causes considerable economic loss, especially when incidence exceeds the average of 5-10% [8]. The fertility of cows after retention of the placenta appeared to be affected. Generally, retention of placenta has great influence on productivity. For instance, retained placenta had a significant negative effect on milk yield for several weeks after calving and there is considerable milk loss as a result of difficult of calving [67].

Reduce conception rate

Varies studies reported that the conception rate of cows presenting retained placenta were significantly lower compared to normally calved cows [68]. The highest proportion of normal cows was conceived during the period from 61 to 90 days after parturition, while cows with retained placenta were conceived at more than 120 days after parturition [41].

Delaying post-delivery service interval

Placental retention is usually accompanied by delayed involution of the uterus [17], and adversely affects reproductive performance [69]. Cows with reproductive disorders had longer intervals from calving to first service and to conception and required more services per conception and lower pregnancy rate and conception to first service [68]. The period from parturition to the first service was longer in cows exhibiting retained placenta compared to normal ones [41].

Longer calving interval

Retention of placenta and metritis may cause prolonged calving interval and permanent infertility. Calving interval remained longer in cows revealing retained placenta as compared to normal cows [41, 69]. In general, the financial losses due to retained placenta in dairy cattle existed due to increased calving interval, increased culling rate, reduced conception rate, infertility, loss of milk production, the costs of veterinary service and drugs.

Treatment

It is important to clearly establish the objective of RP treatment. Many antimicrobial and hormonal treatments have been applied to cows with RP, generally without any reduction in risk of subsequent disease (such as displaced abomasum) or improvement in reproductive performance [17, 22, 70, 71, 72]. The use of antimicrobial therapy in the treatment of RFM has demonstrated conflicting results [14]. Postpartum metritis is common sequelae of RFM, and the rationale behind antibiotics for RFM is to prevent or treat metritis and its subsequent negative effects on fertility. Tetracycline antibiotics commonly used for intrauterine treatment in cattle, inhibit MMPs and might therefore interfere with the normal placental detachment mechanisms [73]. Daily intrauterine (IU) infusions of 5 g oxytetracycline for as long as the RP is in place reduced the incidence of fever from approximately 50% of cows with RP to approximately 30% of affected cows. However, the administration of intrauterine antibiotics did not reduce the incidence of metritis following RFM and could not improve fertility parameters [74].

And also ceftiofur (1.1 mg/kg IM q 24 h for 5 days) in cows with RP and fever was as effective (67% absence of fever by 10 days in milk (DIM)) as a combination of systemic and IU ampicillin and manual removal of the placenta; there was no difference in reproductive performance between the two treatments [75]. An experimental injection of collagenase into the placental end of the umbilical artery has been shown to facilitate separation of the placenta from the uterus [29]. Systemic antibiotics are believed to be beneficial in RFM cases [76].

The hormone which are used for treating retention of fetal membranes or retained of placenta are prostaglandins and oxytocin. These hormones play a role in uterine contraction and could be effective in treating RFM because of uterine atony. However, it is thought that uterine atony accounts for a very small percentage of retained placenta cases and numerous studies have not supported their use as a general treatment for RFM [77]. Oxytocin has long been advocated to expel the placenta after delivery. There are other advantages to the use of oxytocin after calving but it does not reduce the incidence of retained placenta. Oxytocin is already being secreted by normal cows at parturition and it helps contract the uterus and expel a placenta that is fully detached. The contraction of the uterus helps control bleeding from the various sites that may have been traumatized during delivery. If the placenta is not detached from the caruncles oxytocin will not hasten its passage [78]. Additionally oestradiol and the synthetic stilbene, stilboestrol, have been widely used in the treatment of retained placenta. They were thought to have beneficial effects by increasing uterine tone, and particularly by increasing the response to oxytocin [79].

Historically, manual removal of RP by manipulation and traction was practiced. There is no evidence that this practice produces beneficial results [80], and some evidence suggests that it is harmful [14]. Several studies indicate that approximately 50–80% of cows with untreated RP will have a temperature >39.5 _C on at least 1 day within 10 days postpartum [57, 71, 75, 80, 81].

Manual removal can result in more frequent and severe uterine infections, when compared with more conservative treatment[14]. Bolinder et al.,[14] found that manual removal prolonged the interval from calving to1st functioning CL by 20 days. Additionally, intrauterine pathogenic bacteria were found in 100% of cows with manually removed RFM versus 37% of untreated cows at 3 weeks postpartum, and further 37% of treated versus 12% of untreated cows at 5 weeks postpartum. While current evidence does not support manual removal as an effective treatment for RFM, it is still commonly practiced [17]. And also as Drillich *et al*., [72] demonstrated that 84.3% of the cows after manual removal of the placenta developed fever. Furthermore, remnants of cotyledons were found on caruncles, and hemorrhages and thrombi could be seen microscopically in cows after assumed removal of RFM [21]. Nevertheless, the manual removal of RFM together with the administration of tetracycline boli is still the routine treatment [82, 83].

Prevention and control

The control of retained placenta needs to focus on the control of causative factors like abortions, premature calving, calving difficulties, and vitamin and mineral deficiencies. Milk fever and even sub-clinical calcium deficiency can be associated with an increased risk of RFM [84, 85] with older cows more at risk of lower blood calcium. Then it needs tob controlled. Good control of feeding and condition during the dry period and avoiding cows becoming overfat will also reduce the incidence of retained placenta. The herds with a history of selenium deficiency had a high incidence of RFM, and according to their suggestion supplementation of vitamin E and selenium can help to reduce placental retention [35, 86]. The synthetic form of vitamin E (alpha-tocopherol acetate) was found to be more effective than the natural form of vitamin E [35]. Supplementation with balanced vitamin and mineral mixture in prepartum period is considered a prophylactic step to avoid fetal membrane retention. Although these vitamins and minerals can be supplemented, correct pasture based diet formulation could prevent the need for additional supplementation. For example, Beeckman et al.,[87] showed that grass clover silage and mixed silage were shown to have significantly more vitamin E than hay, maize or grain. The infectious diseases can be prevented by proper immunization against specific infection.

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